

GILBERT RIVER BED SAND INVESTIGATION

EXPLORATORY DRILLING PROGRAMME

DECEMBER 1998
REFERENCE NO. ES 1050

Engineering Services
Water Engineering Consultants



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GULF REGION STUDY

REPORT ON THE GILBERT RIVER EXPLORATORY DRILLING PROGRAMME

GILBERT RIVER BORE-HOLE LINES CROSS-SECTION PLOTS

REGIONAL INFRASTRUCTURE DEVELOPMENT, MARREBA.
SEPTEMBER - OCTOBER 1998

Sieve Analysis
 Record # 23
 Location **Godfrey's**
 Sample# 2

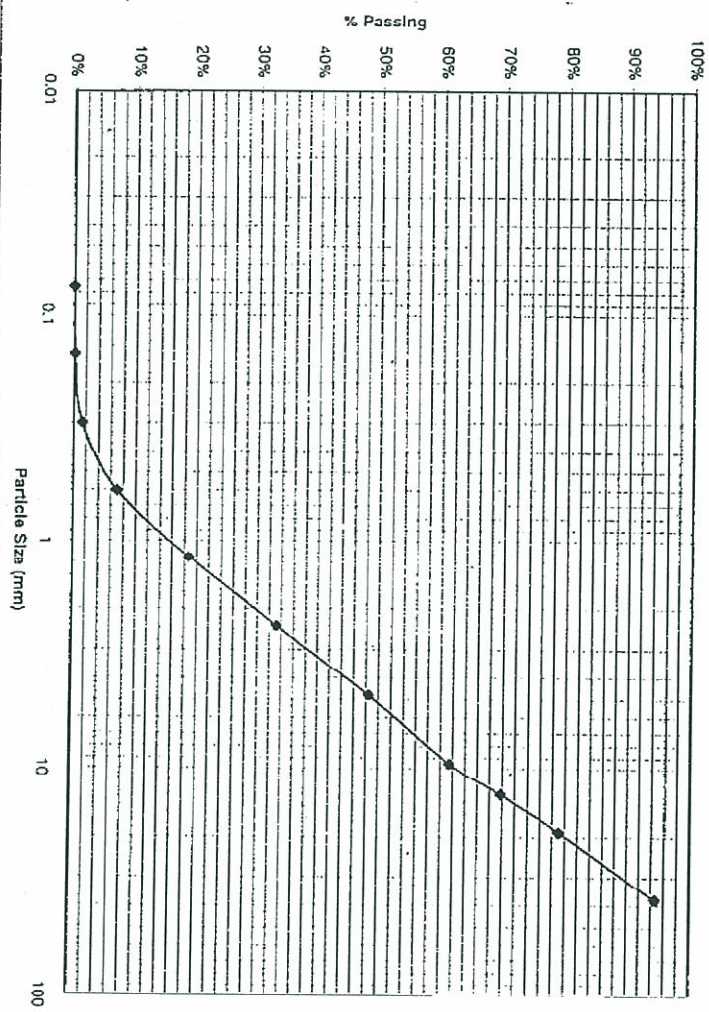
Depth 3 metres to 4 m
 Sample Mass 1934 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
37.5	1053	105.3	105.3	5.44%	94.56%
19	300	405.3	510.6	26.38%	73.62%
13	180.2	585.5	1096.1	35.44%	64.56%
9.5	161	746.5	1842.6	48.93%	51.07%
4.75	252.9	999.4	2842.0	69.41%	30.59%
2.36	293.4	1292.8	4134.8	81.15%	18.85%
1.18	279.6	1572.4	5707.2	93.45%	6.55%
0.6	226.8	1799.2	7506.4	98.56%	1.44%
0.3	107.6	1906.8	9413.2	98.84%	1.16%
0.15	24.1	1930.9	11344.1	99.82%	0.18%
0.075	2.7	1933.6	13277.7	99.98%	0.02%
Pan		0.36			
Total			1933.96		

Gravel Pack

D10 0.750
 D60 8.991

Effective Grain Size 0.750
 Uniformity Coefficient 11.989



Sieve Analysis

GULF REGION STUDY
Gilbert River Exploratory Drilling Programme
Grain Size Distribution Curve for Representative Sand / Gravel Samples

Sieve Analysis
 Record # 22
 Location **Godfrey's**
 Sample# 1

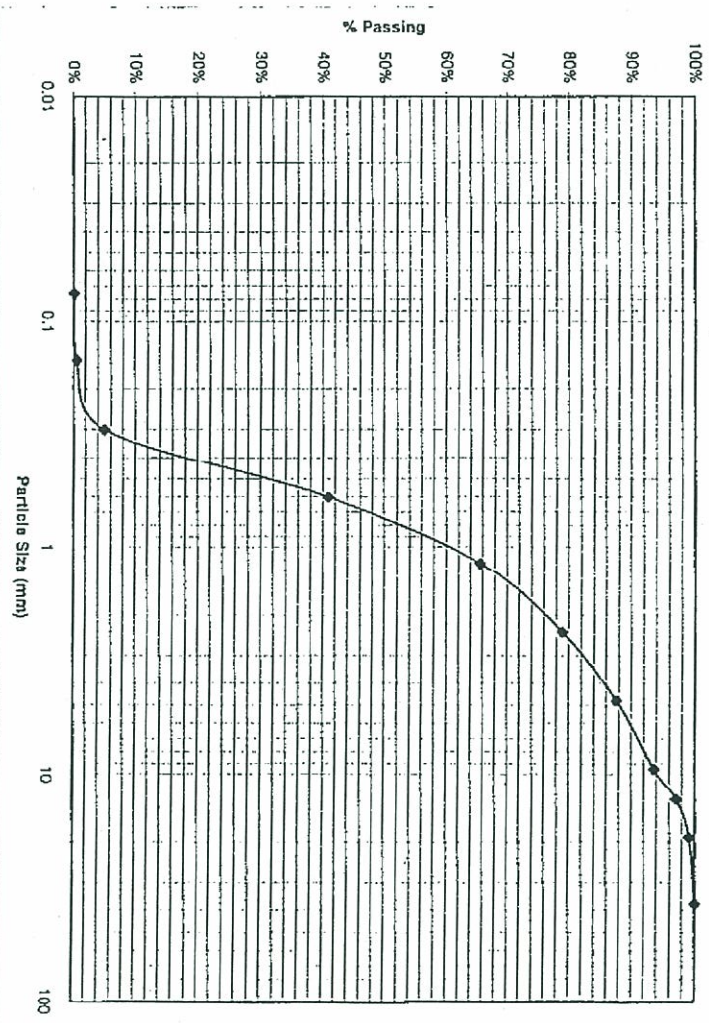
Depth 1 metres to 2 m
 Sample Mass 1472 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (g)	Percent Passing (Cum.) (g)
37.5		0	0	0.00%	100.00%
19		13	13	0.88%	99.12%
13		30	43	2.92%	97.08%
9.5		51.3	94.3	6.41%	93.59%
4.75		87.9	182.2	12.38%	87.62%
2.36		127.4	309.6	21.04%	78.96%
1.18		196.3	505.9	34.38%	65.62%
0.6		364.5	870.4	59.15%	40.85%
0.3		526.9	1397.3	94.96%	5.04%
0.15		66	1463.3	99.44%	-0.56%
0.075		7.1	1470.4	99.93%	0.07%
Pan		1.1			
Total			1471.5		

Gravel Pack

D10 0.317
 D60 1.048
 Effective Grain Size 0.317
 Uniformity Cefficient 3.304

Sieve Analysis



GULF REGION STUDY
Gilbert River Exploratory Drilling Programme
 Grain Size Distribution Curve for Representative
 Sand / Gravel Samples

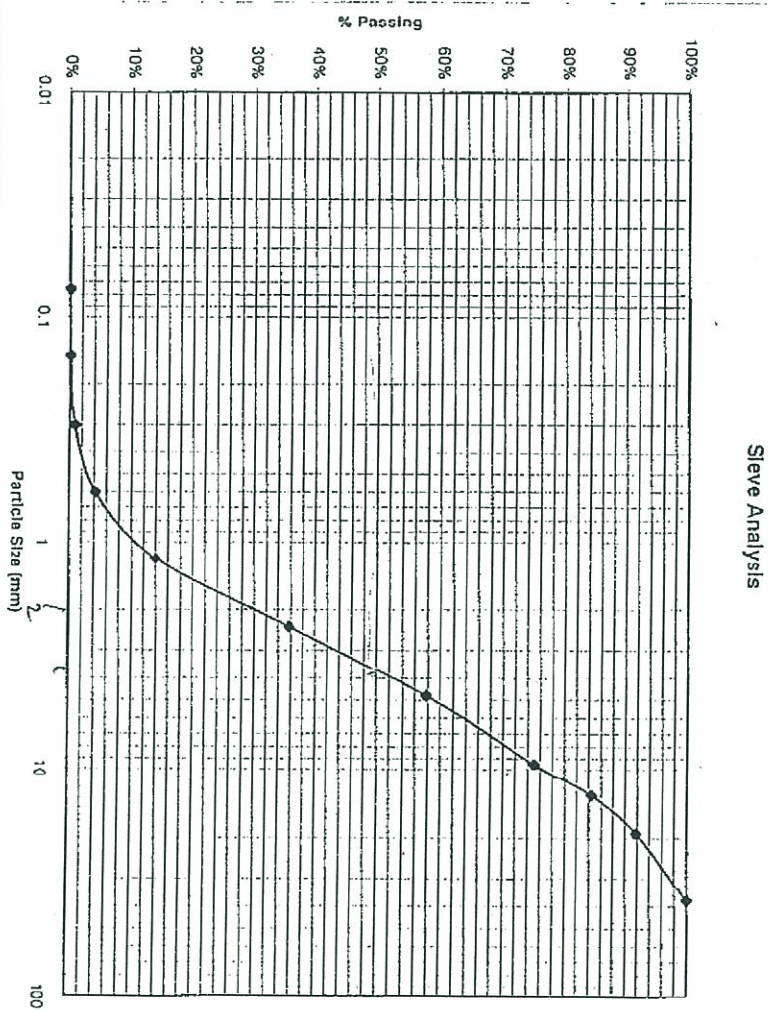
Sieve Analysis
Record # 21
Location **Bridge**
Sample# 5

Depth 9 metres to 10 m
Sample Mass 2106 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (g)	Percent Passing (Cum.) (g)
37.5		0	0	0.00%	100.00%
19		174.6	174.6	8.29%	91.71%
13		154.9	329.5	15.64%	84.36%
9.5		196.8	526.3	24.97%	75.03%
4.75		364.2	890.5	42.26%	57.74%
2.36		465	1355.5	64.32%	35.68%
1.18		457.8	1813.3	86.04%	13.96%
0.6		206.2	2019.5	95.89%	4.17%
0.3		69.4	2088.9	99.42%	0.88%
0.15		15.2	2104.1	99.84%	0.16%
0.075		2.3	2106.4	99.95%	0.05%
Pan		1			
Total			2107.4		

Gravel Pack

D10 0.594
D60 2.130
Effective Grain Size 0.594
Uniformity Coefficient 3.586



GULF REGION STUDY
Gilbert River Exploratory Drilling Programme
Grain Size Distribution Curve for Representative
Sand / Gravel Samples

Sieve Analysis
Record # 18
Location **Bridge**
Sample# 2

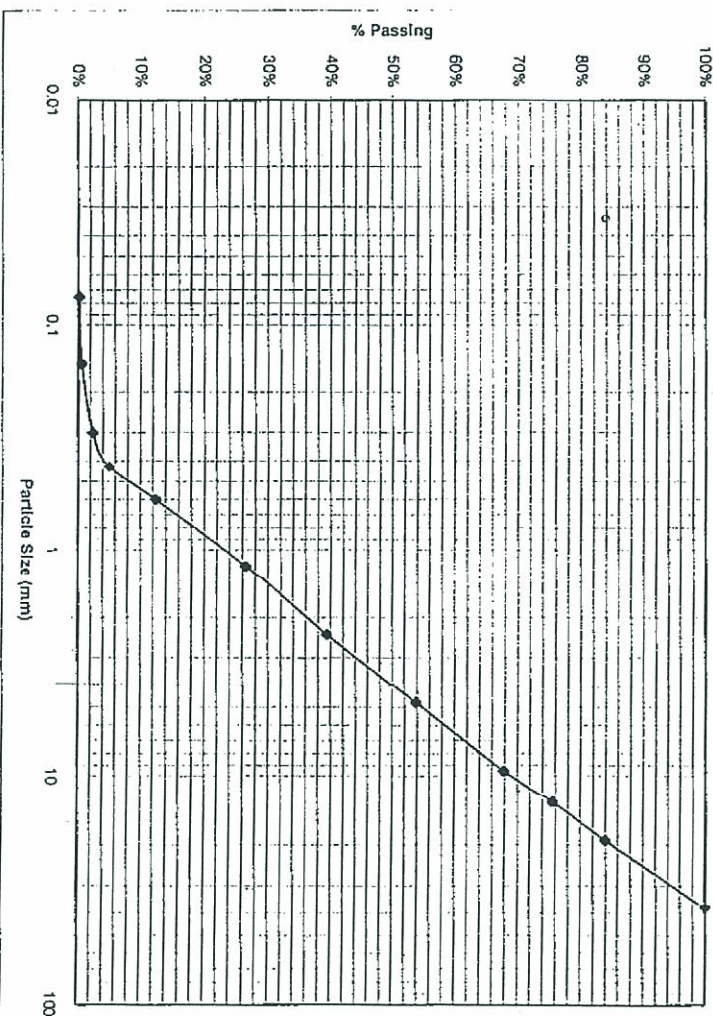
Depth 3 metres to 4 m
Sample Mass 1852 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
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37.5	0	0	0.00%	100.00%
19	297.6	297.6	16.09%	83.91%
13	155.1	452.7	24.48%	75.52%
9.5	143	595.7	32.21%	67.79%
4.75	258	853.7	46.17%	53.83%
2.36	268.3	1122	60.67%	39.33%
1.18	236.8	1358.8	73.48%	26.52%
0.6	260.1	1618.9	87.55%	12.45%
0.425	137.3	1756.2	94.97%	5.03%
0.3	48.6	1804.8	97.60%	2.40%
0.15	33.6	1838.4	99.42%	0.58%
0.075	7.6	1846	99.83%	0.17%
Pan	3.2			
Total		1849.2		

Gravel Pack

D10 0.542 Effective Grain Size
D60 6.849 Uniformity Coefficient 12.633



Sieve Analysis

GULF REGION STUDY
Gilbert River Exploratory Drilling Programme
Grain Size Distribution Curve for Representative Sand / Gravel Samples

Sieve Analysis

Record # 10

Location **Forest Home #2**

Sample# 3

Depth 6 metres to 7 m

Sample Mass 1974.2 (g)

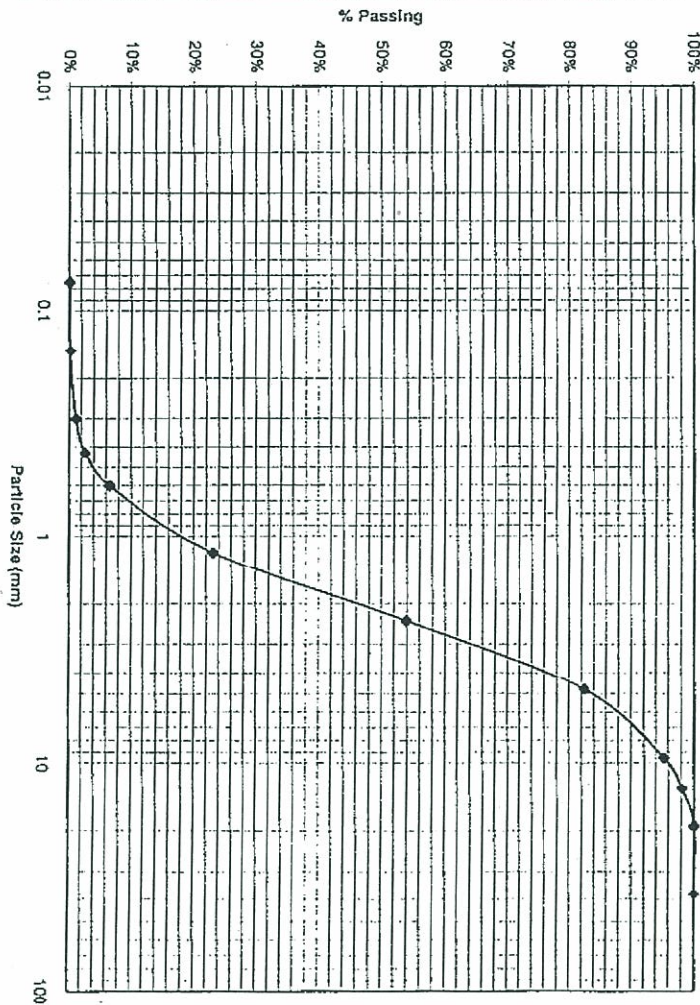
ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
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37.5	0	0	0	0.00%	100.00%
19	0	0	0	0.00%	100.00%
13	36.8	36.8	36.8	1.87%	98.13%
9.5	56.5	56.5	93.3	4.73%	95.27%
4.75	252.5	252.5	345.8	17.54%	82.46%
2.36	563.8	563.8	909.6	46.15%	53.85%
1.18	606.8	606.8	1516.4	76.93%	23.07%
0.6	327	327	1843.4	93.52%	6.48%
0.425	77.25	77.25	1920.65	97.44%	2.56%
0.3	29.2	29.2	1949.85	98.92%	1.08%
0.15	17.6	17.6	1967.45	99.82%	0.18%
0.075	2.4	2.4	1969.85	99.94%	0.06%
Pan	1.2	1.2			
Total			1971.05		

Gravel Pack

D10	0.723	Effective Grain Size	0.723
D60	2.874	Uniformity Coefficient	3.974

Sieve Analysis



GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative Sand / Gravel Samples

Sieve Analysis

Record # 8

Location **Forest Home #2**

Sample# 1

Depth 2 metres to 3 m
Sample Mass 2187 (g)

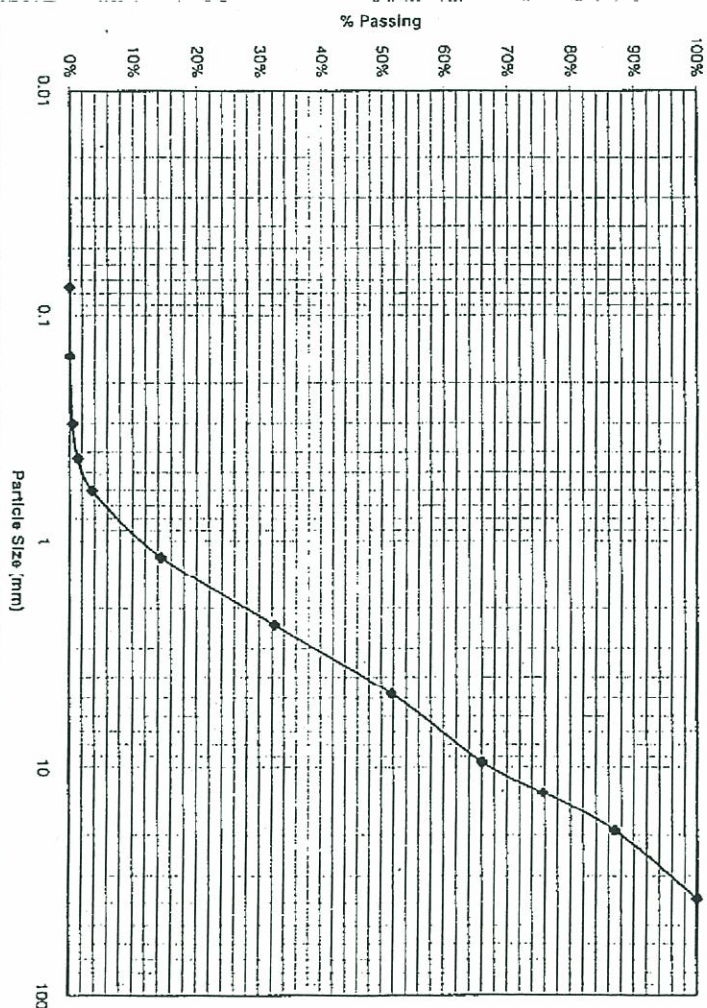
ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (g)	Percent Passing (Cum.) (g)
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37.5	0	0	0.00%	100.00%
19	285.8	285.8	13.08%	86.92%
13	245.1	530.9	24.31%	75.69%
9.5	211.3	742.2	33.98%	66.02%
4.75	314	1056.2	48.36%	51.64%
2.36	419.9	1476.1	67.58%	32.42%
1.18	391.8	1867.9	85.52%	14.48%
0.6	238.1	2106	96.42%	3.58%
0.425	50.3	2156.3	98.72%	1.28%
0.3	16.9	2173.2	99.50%	0.50%
0.15	10.1	2183.3	99.96%	0.04%
0.075	0.8	2184.1	100.00%	0.00%
Pan	0.1			
Total		2184.2		

Gravel Pack

D10 0.942 Effective Grain Size
D60 7.511 Uniformity Coefficient

Sieve Analysis



GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative
Sand / Gravel Samples

Sieve Analysis

Record # 16

Location **Blancourt #4**

Sample# 2

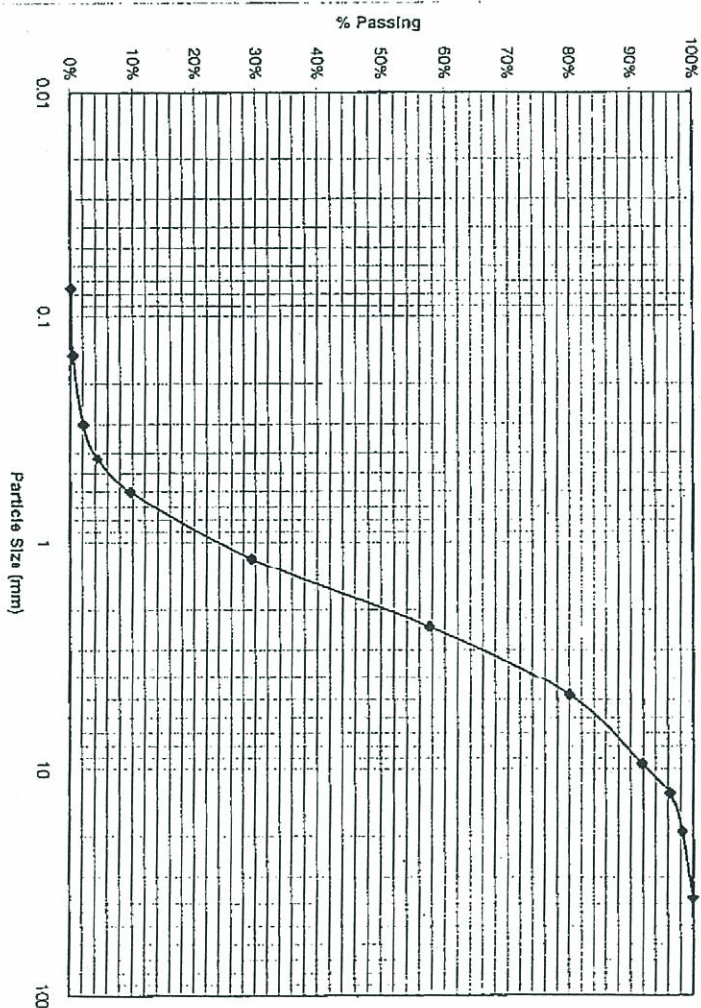
Depth 4.2 metres to 5 m
Sample Mass 2103 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
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37.5	0	0	0.00%	100.00%
19	37.1	37.1	1.77%	98.23%
13	40.7	77.8	3.71%	96.29%
9.5	94.7	172.5	8.24%	91.76%
4.75	246.4	418.9	20.00%	80.00%
2.36	471.7	890.6	42.52%	57.48%
1.18	589.4	1480	70.66%	29.34%
0.6	413	1893	90.38%	9.62%
0.425	109.9	2002.9	95.63%	4.37%
0.3	48	2050.9	97.92%	2.08%
0.15	34.1	2085	99.55%	0.45%
0.075	7.2	2092.2	99.89%	0.11%
Pan	2.2			
Total		2094.4		

Gravel Pack

D10 0.611
D60 2.628
Effective Grain Size
Uniformity Coefficient



Sieve Analysis

GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative
Sand / Gravel Samples

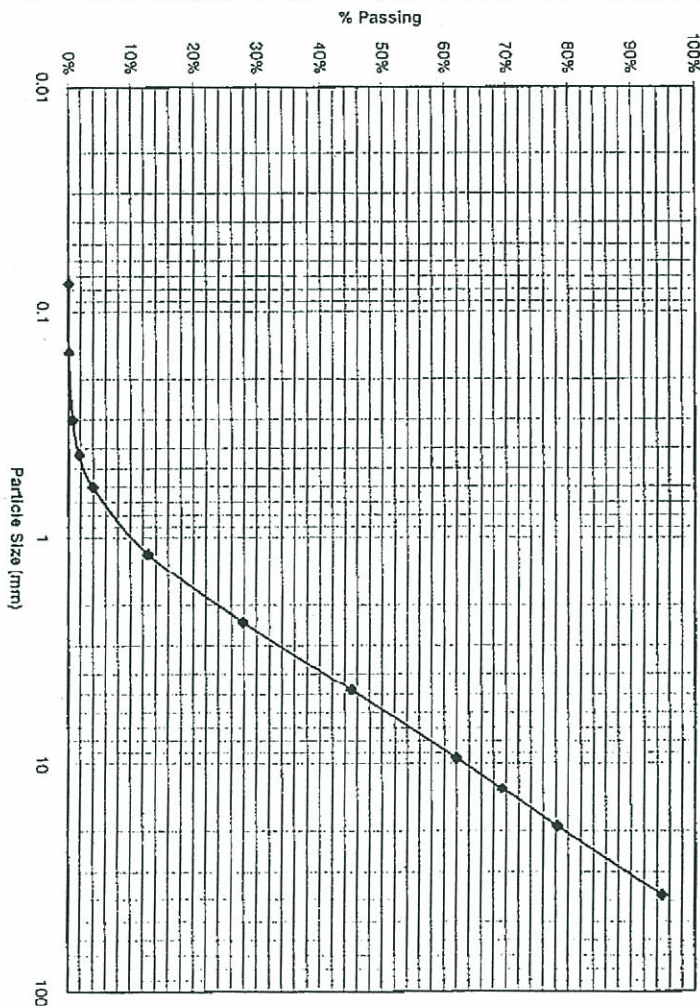
Sieve Analysis
Record # 15
Location **Blancourt #4**
Sample# 1

Depth 2 metres to 3 m
Sample Mass 2485 (g)

ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
37.5		129.5	129.5	5.21%	94.79%
19		410.5	540	21.75%	78.25%
13		220.4	760.4	30.62%	69.38%
9.5		183.3	943.7	38.00%	62.00%
4.75		421.3	1365	54.97%	45.03%
2.36		427.1	1792.1	72.17%	27.83%
1.18		373.7	2165.8	87.21%	12.79%
0.6		219.9	2385.7	96.07%	3.93%
0.425		54.6	2440.3	98.27%	1.73%
0.3		25.6	2465.9	99.30%	0.70%
0.15		15.8	2481.7	99.94%	0.06%
0.075		1.3	2483	99.99%	0.01%
Pan		0.3			
Total			2483.3		

Gravel Pack

D10 0.998 Effective Grain Size
D60 8.941 Uniformity Coefficient



Sieve Analysis

GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative
Sand / Gravel Samples

Sieve Analysis

Record # 6

Location **Riverview #4**

Sample# 6

Depth 10 metres to 11 m

Sample Mass 2355 (g)

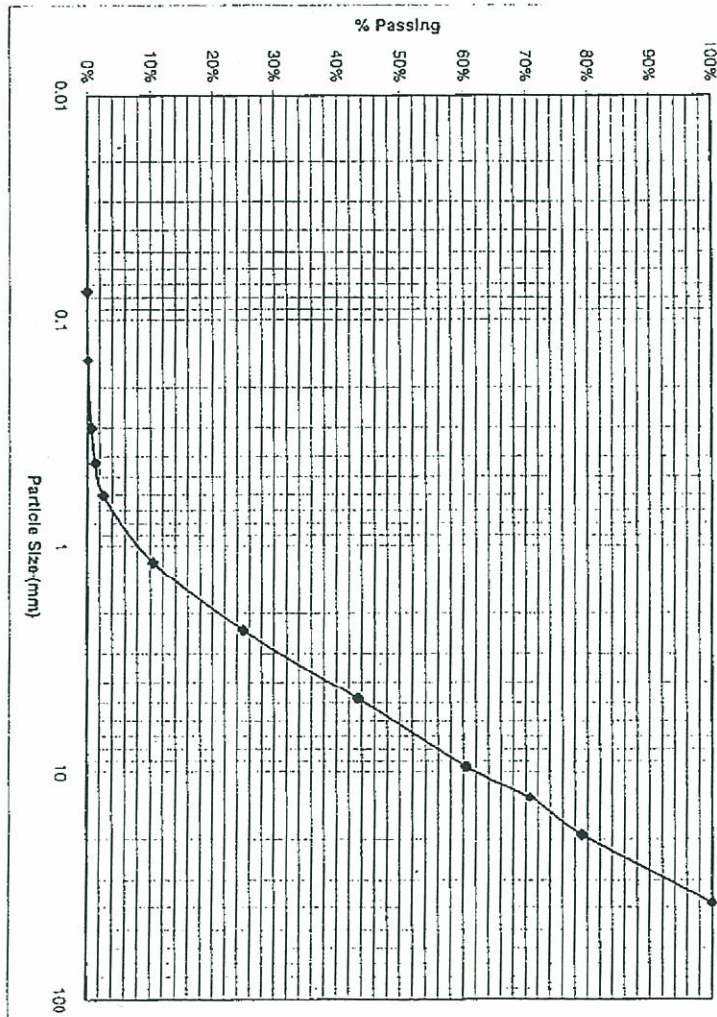
ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
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37.5	0	0	0.00%	100.00%
19	491.8	491.8	20.91%	79.09%
13	197.7	689.5	29.32%	70.68%
9.5	241.6	931.1	39.59%	60.41%
4.75	400	1331.1	56.60%	43.40%
2.36	433.3	1764.4	75.03%	24.97%
1.18	342.4	2106.8	89.59%	10.41%
0.6	184.7	2291.5	97.44%	2.56%
0.425	30.9	2322.4	98.76%	1.24%
0.3	13.7	2336.1	99.34%	0.66%
0.15	13.2	2349.3	99.90%	0.10%
0.075	1.9	2351.2	99.98%	0.02%
Pan	0.4			
Total		2351.6		

Gravel Pack

D10 1.150 Effective Grain Size
D60 9.387 Uniformity Coefficient

Sieve Analysis



GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative Sand / Gravel Samples

Sieve Analysis

Record # 3

Location **Riverview #4**

Sample# 3

Depth 4 metres to 5 m

Sample Mass 2288 (g)

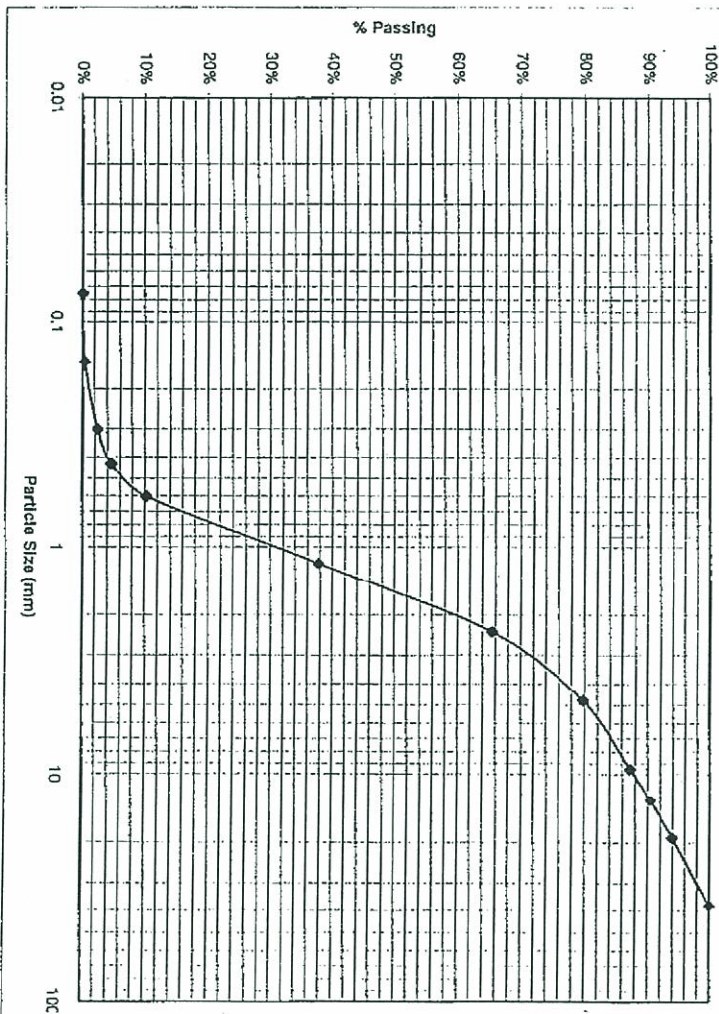
ASTM sieve no.	Aperture (mm)	Mass Retained (g)	Mass Retained (Cum.) (g)	Percent Retained (Cum.) (%)	Percent Passing (Cum.) (%)
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37.5	0	0.00%	100.00%
19	139.2	6.09%	93.91%
13	79.1	9.56%	90.44%
9.5	74.9	12.84%	87.16%
4.75	169.4	20.25%	79.75%
2.36	328	34.61%	65.39%
1.18	631.4	62.26%	37.74%
0.6	629.3	89.81%	10.19%
0.425	127.1	21.78.4	95.37%
0.3	50.3	2228.7	97.57%
0.15	47.9	2276.6	99.67%
0.075	7	2283.6	99.98%
Pan	0.5		0.02%
Total		2284.1	

Gravel Pack

210	0.594	Effective Grain Size	0.594
360	2.130	Uniformity Coefficient	3.586

Sieve Analysis



GULF REGION STUDY

Gilbert River Exploratory Drilling Programme

Grain Size Distribution Curve for Representative Sand / Gravel Samples

GULF REGION STUDY

REPORT ON THE GILBERT RIVER EXPLORATORY DRILLING PROGRAMME

GRAIN-SIZE DISTRIBUTION CURVES FOR REPRESENTATIVE
SAND / GRAVEL SAMPLES

REGIONAL INFRASTRUCTURE DEVELOPMENT, MAREEBA.
SEPTEMBER - OCTOBER 1998

Rec'd Location	Samp. #	Depth1	Depth2	Mass	m.r.37.5	m.r. 19	m.r. 13	m.r. 9.5	m.r.4.75	m.r.2.36	m.r.1.1	m.r.0.6	m.r.0.45	m.r. 0.3	m.r.0.15	m.r.0.075	pan	d10	d60	Cu	d10 sort	d60 sort	Cu sort	Sort	CU	Location	Cu
1 Riverview #	1	0	1	2298	248	201.5	48.7	48.7	162.5	161	248.7	638.7	329.2	151.3	109.3	9	1	0.391	1.844	4.716	0.317	1.048	3.304	22 Godfrey's	3.304		
3 Riverview #	2	4	5	2288	0	139.2	79.1	74.9	169.4	328	631.4	629.3	127.1	50.3	47.3	7	0.5	0.594	2.130	3.586	0.391	1.318	3.586	3 Riverview #4	3.586		
2 Riverview #	3	2	3	2208	0	46.9	97.8	126.7	204.7	568.6	469.2	143.4	0	68.6	33.3	3.8	0.5	0.896	3.862	4.311	0.391	1.344	3.586	21 Bridge	3.586		
4 Riverview #	4	6	7	2165	233.04	162.2	115.4	135.2	369.8	378.6	336.3	280.6	77.2	39.6	36.7	4	0.6	0.723	6.655	9.200	0.457	1.344	3.835	7 Riverview #4	3.835		
5 Riverview #	5	8	9	2395	212.5	75.9	61.8	79.4	209.9	423.4	515.3	444.7	150.2	94.3	82.5	12	1.5	0.482	3.125	6.483	0.479	2.024	3.974	10 Forest Hom	3.974		
7 Riverview #	6	10	11	2355	0	491.8	197.7	241.6	400	433.3	342.4	184.7	30.9	13.7	13.2	1.9	0.4	1.150	9.387	8.164	0.482	2.130	3.974	12 Forest Hom	3.974		
8 Forest Hom	1	2	3	2187	0	285.8	245.1	211.3	314	419.9	391.8	238.1	50.3	16.9	10.1	0.8	0.1	0.942	7.511	7.977	0.542	2.328	4.223	24 Godfrey's	4.223		
9 Forest Hom	2	4	4.7	2183	0	788.5	386.5	221.9	352.9	282.4	129.8	33.3	3.8	1.5	1.5	0.3	0.2	0.798	1.789	6.323	0.594	2.374	4.299	16 Bancourt #4	4.299		
10 Forest Hom	3	6	7	1974.2	0	0	36.8	56.5	252.5	563.8	606.8	327	77.25	29.2	17.6	2.4	1.2	0.723	2.874	3.974	0.594	3.053	4.311	2 Riverview #4	4.311		
11 Forest Hom	4	8	8.5	1739	0	116.4	51.9	77.8	199.8	947.3	409.4	375.2	94.3	36.9	25.8	2.5	0.8	0.391	1.844	4.716	0.611	3.125	4.716	1 Riverview #4	4.716		
12 Forest Hom	5	10	10	1885	0	16.8	16.3	16.3	99.5	326.9	600.9	470.9	176.5	95	53	6.6	1.4	0.457	1.818	3.979	0.723	3.611	4.716	11 Forest Hom	4.716		
13 Forest Hom	6	9	10	1939	0	308.4	141.9	135.3	307.8	380.5	369.4	205.6	49.8	23.8	12.9	1.7	1	0.895	6.573	7.344	0.723	3.862	5.720	14 Forest Hom	5.720		
14 Forest Hom	7	10	11	2419	0	43.9	96.9	158.1	352.8	450	498.5	501	198	65	39.1	5	0.9	0.541	3.093	5.720	0.750	6.453	6.323	9 Forest Hom	6.323		
15 Bancourt #	1	2	3	2485	129.5	410.5	220.4	183.3	421.3	427.1	373.7	219.9	54.6	25.6	15.8	1.3	0.3	0.398	3.941	8.962	0.895	6.573	6.483	5 Riverview #4	6.483		
16 Bancourt #	2	4	5	2163	0	37.1	40.7	94.7	246.4	471.7	589.4	413	109.9	48	34.1	7.2	2.2	0.611	2.628	4.299	0.896	6.655	7.344	13 Forest Hom	7.344		
17 Bridge	1	1	2	2050	0	141	84.8	91.2	135.1	243.3	385.4	524.6	353.2	59.5	36.2	2.9	0.3	0.479	2.024	4.223	0.942	6.849	7.977	8 Forest Hom	7.977		
18 Bridge	2	3	4	1852	0	297.6	155.1	143	258	268.3	226.8	260.1	137.3	48.6	33.6	7.6	3.2	0.542	5.849	12.633	0.942	7.511	8.164	6 Riverview #4	8.164		
19 Bridge	3	5	6	2217	97	430.9	270.2	239.2	333.8	374.6	234.3	133.2	0	76.6	20	3	0.7	1.127	11.723	10.401	0.988	8.941	8.962	15 Bancourt #4	8.962		
20 Bridge	4	7	8	1773	0	570.6	138.4	104.2	183.2	307	301.4	112.3	0	41.6	9.2	1.6	0.3	1.227	13.047	10.634	1.127	8.991	9.200	4 Riverview #4	9.200		
21 Bridge	5	9	10	2108	0	174.6	164.9	196.8	364.2	465	457.8	206.2	0	526.9	86	2.3	1	0.594	2.130	3.586	1.150	9.387	10.401	19 Bridge	10.401		
22 Godfrey's	1	1	2	1472	0	13	30	51.3	87.9	127.4	196.3	36.5	0	526.9	86	7.1	1.1	0.317	1.048	3.304	1.227	11.723	10.634	20 Bridge	10.634		
23 Godfrey's	2	3	4	1934	105.3	300	180.2	161	252.9	239.4	279.6	226.8	0	107.6	24.1	2.7	0.36	0.750	8.991	11.986	1.534	13.047	11.989	23 Godfrey's	11.989		
24 Godfrey's	3	5	6	2206	0	119	206.3	224	519.1	660.6	365.6	93.8	0	15.4	1.5	0.2	0.1	1.534	6.453	4.206	2.798	17.689	12.633	18 Bridge	12.633		

Mean 0.838 5.660 6.440
Median 0.723 3.736 5.218

GULF REGION STUDY

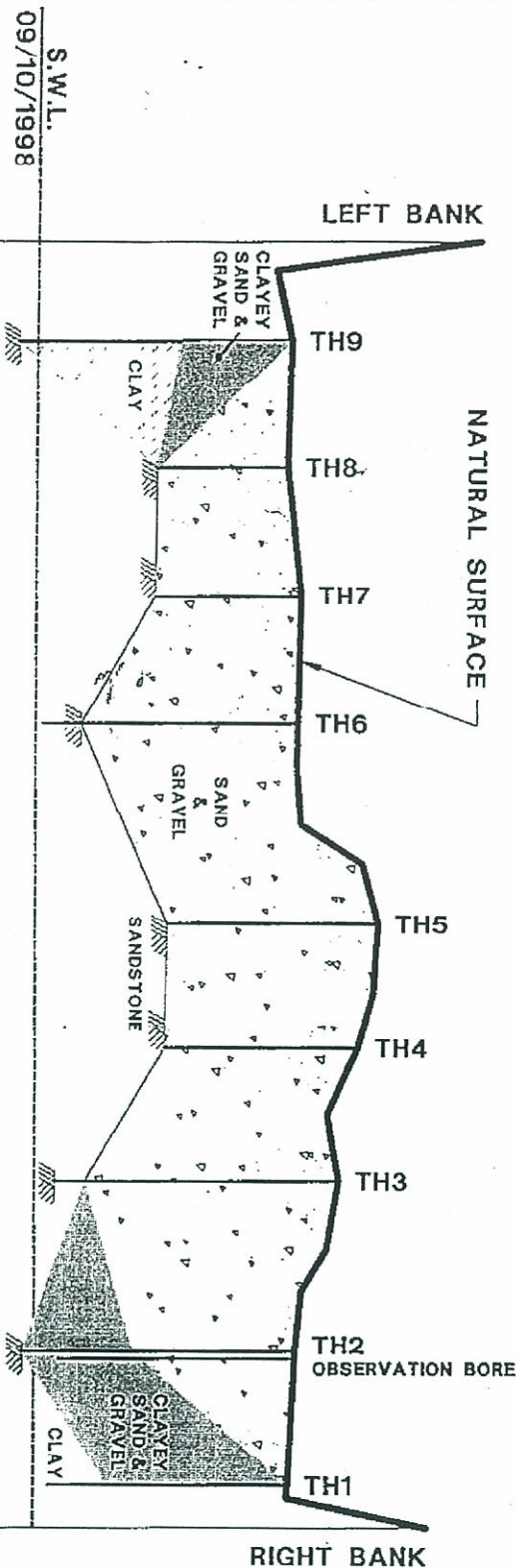
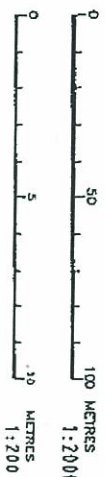
Gilbert River Exploratory Drilling Programme

Sieve Analysis Data and Coefficient of Uniformity
Values for Sand / Gravel Samples

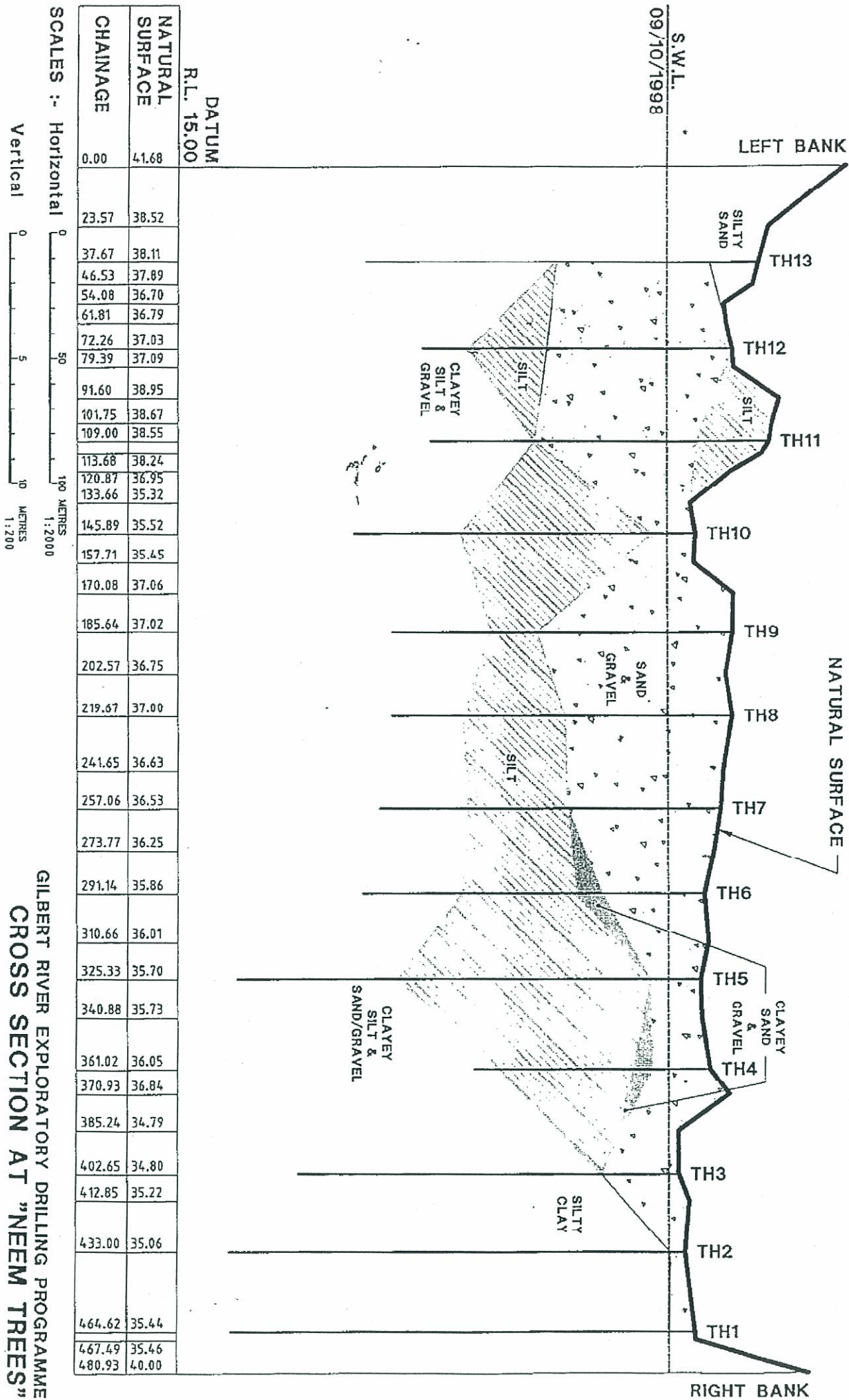
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27.24	26.25	
61.76	26.15	
97.03	26.53	
132.76	26.45	
146.11	26.44	
160.77	26.56	
171.67	28.22	
188.43	28.67	
207.79	28.53	
223.21	28.11	
241.60	27.28	
246.69	27.35	
260.37	27.58	
279.56	27.26	
291.09	26.59	
307.71	26.43	
344.55	26.24	
347.97	26.20	
355.97	30.00	

SCALES :- Horizontal

Vertical



GILBERT RIVER EXPLORATORY DRILLING PROGRAMME
CROSS SECTION AT "GODFREY'S"

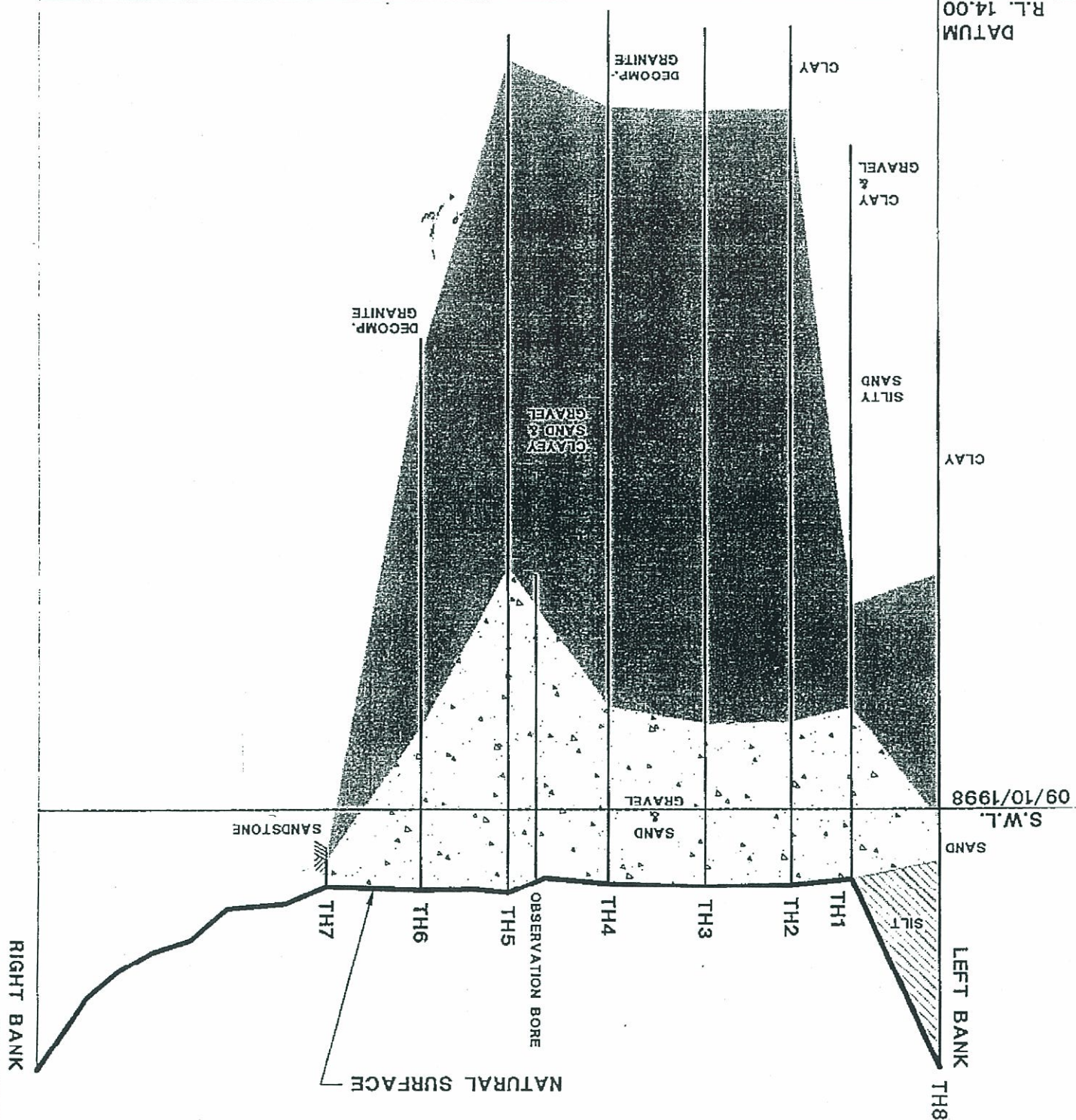


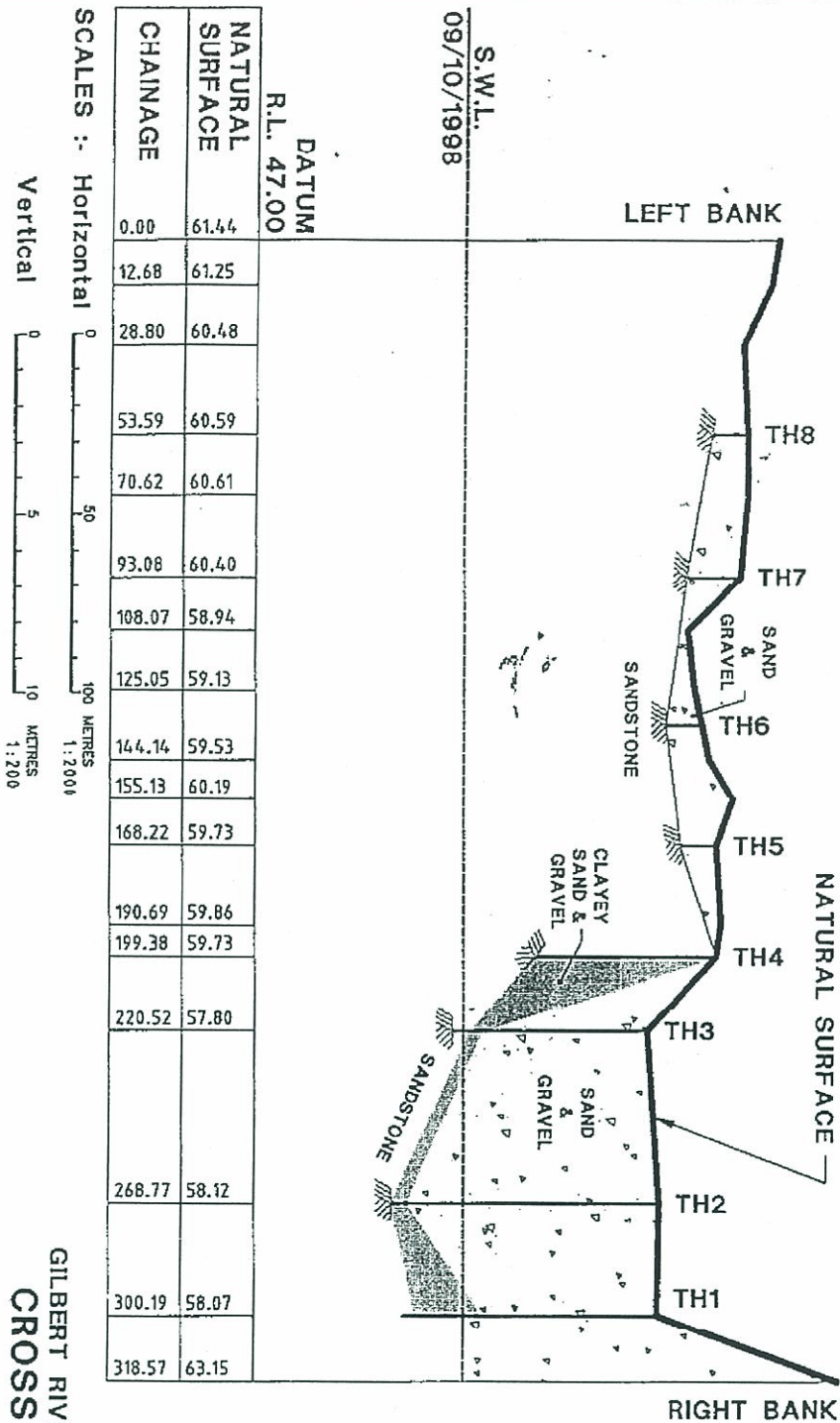
GILBERT RIVER EXPLORATORY DRILLING PROGRAMME CROSS SECTION AT "ROAD BRIDGE"

Vertical
Horizontal



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31.28	46.36	
53.26	46.58	
85.09	46.64	
120.25	46.51	
143.71	46.31	
157.41	46.88	
169.70	46.75	
189.33	46.79	
222.75	46.66	
237.61	47.28	
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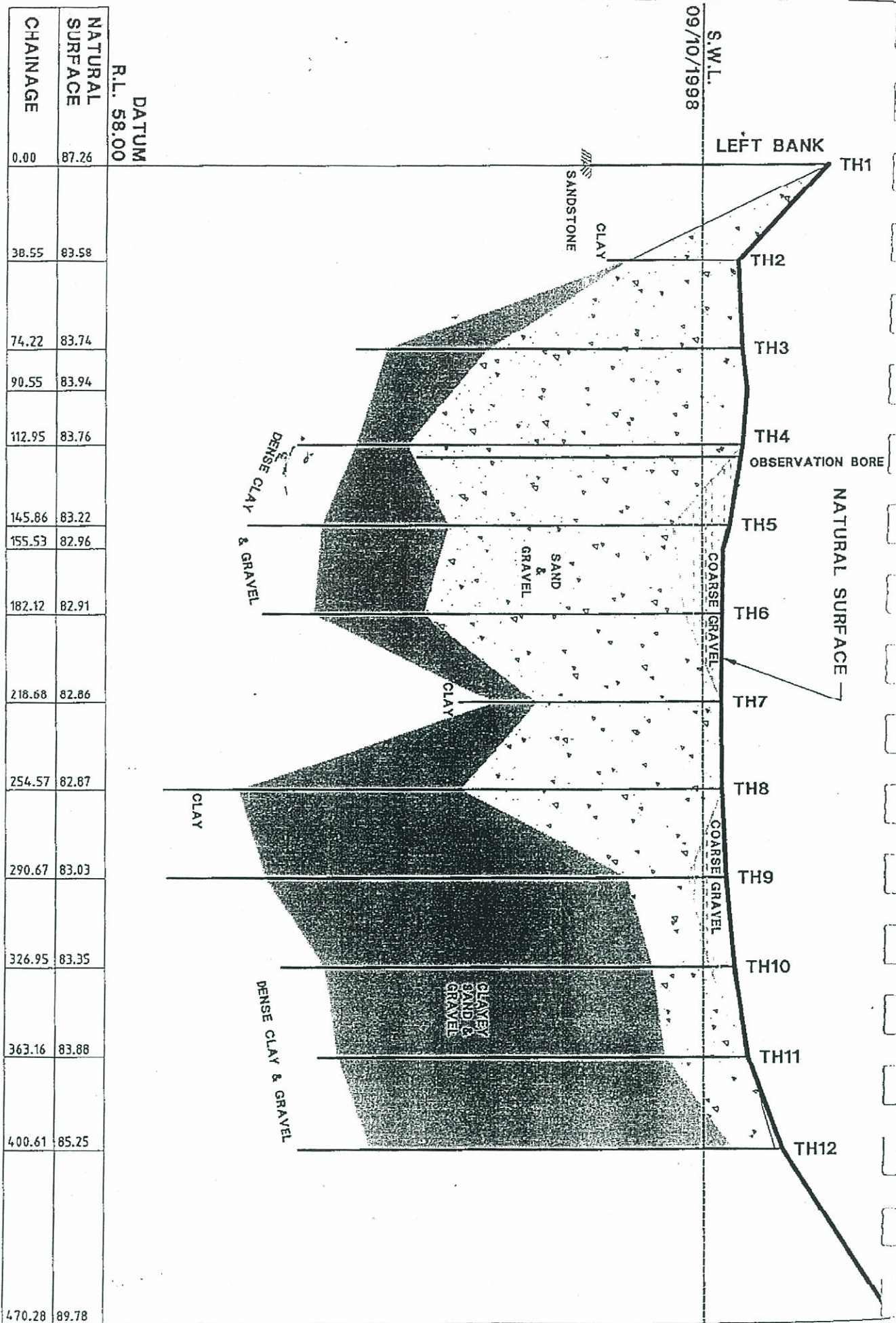


GILBERT RIVER EXPLORATORY DRILLING PROGRAMME
CROSS SECTION AT "ROCKY VIEW"



**GILBERT RIVER EXPLORATORY DRILLING PROGRAMME
CROSS SECTION AT "FOREST HOME"**

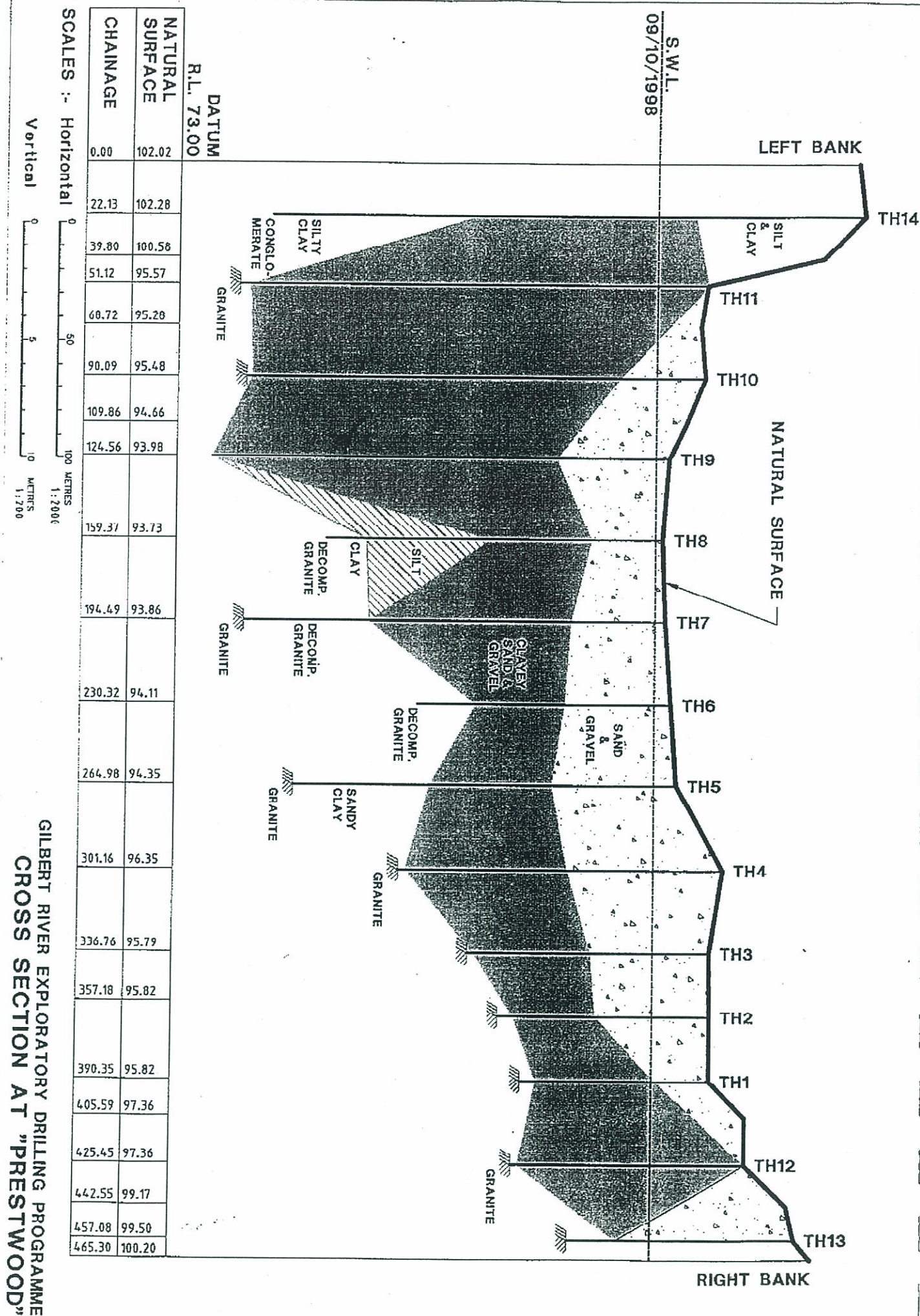




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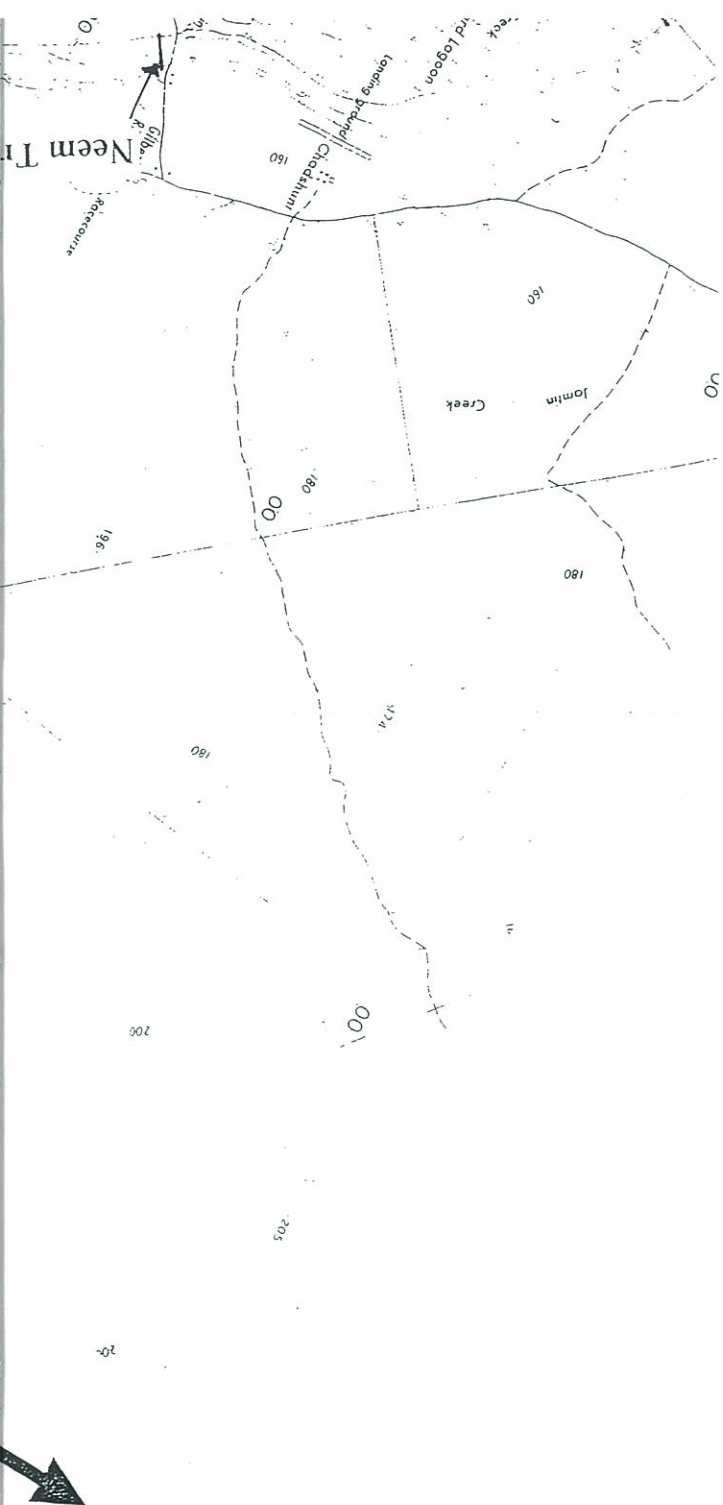
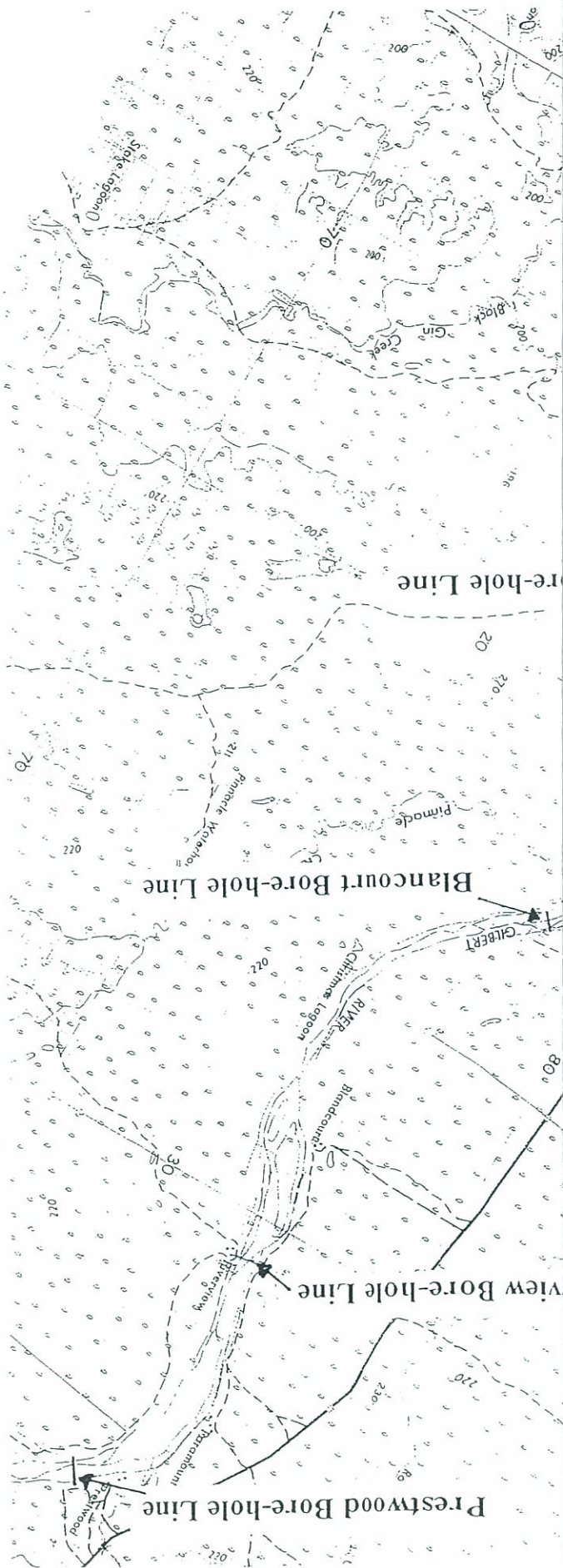
Vertical 0 5 10 METRES
1:200

**GILBERT RIVER EXPLORATORY DRILLING PROGRAMME
CROSS SECTION AT "RIVER VIEW"**



**GILBERT RIVER EXPLORATORY DRILLING PROGRAMME
CROSS SECTION AT "PRESTWOOD"**

Sources - GULF REGION STUDY
ATATORY DRILLING PROGRAMME
Neem Tuality PLAN





DEPARTMENT OF NATURAL RESOURCES
REGIONAL INFRASTRUCTURE DEVELOPMENT
DECEMBER, 1998

GILBERT RIVER BED SAND INVESTIGATION
EXPLORATORY DRILLING PROGRAMME
SEPTEMBER - OCTOBER 1998



GULF REGION STUDY

1050

GULF REGION STUDY

GILBERT RIVER EXPLORATORY DRILLING PROGRAMME

SEPTEMBER - OCTOBER 1998

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J.A. BENJAMIN Former Senior Technical Officer.

Rural Advisory Service / Regional Infrastructure Development.

MAREEBA.

December 1989

GILBERT RIVER EXPLORATORY DRILLING PROGRAMME

SEPTEMBER - OCTOBER 1998

EXECUTIVE SUMMARY

The bed sands of the Gilbert River, West of Georgetown in the eastern Gulf of Carpentaria, have for many years provided reliable water supplies to irrigate suitable soils of the river levees and flood-plain. Lack of quantitative data meant that recent requests to The Department of Natural Resources for additional allocation could not be satisfied with any degree of certainty. A drilling programme was devised to explore the extent and characteristics of the aquifer between "Prestwood" and "Chadshunt", to attempt to provide some indication of the volume of water available from this resource. Eight lines of bore-holes were drilled across the river bed by rotary auger-rig to establish the depth of clean sand and gravel aquifer material. Further percussion drilling at five of the sites was carried out to sample the quality of the aquifer. Measurements of area and depth were used to calculate the volume of the saturated aquifer. This result was integrated with the aquifer characteristics to estimate the volume of water contained in the bed-sands in a steady-state situation. A volume of 18 000 Mfegallitres is indicated.

The amount of water able to be abstracted will be governed not only by the aquifer conditions but also by the location of the abstraction point in relation to the various shallow rock "controls" noted in the investigation. It is recommended that additional investigation be undertaken to determine the contribution made by the unmapped portion of the aquifer under-lying the river banks and to accurately establish the location of the geological features that may influence the hydrology of the system.

1.0 INTRODUCTION

Large areas of well-drained alluvial soil exist on the natural levees and minor flood plains of the Gilbert River. These potentially arable soils are more extensive in the reach from just up-stream of "Prestwood" station to below "Chadshunt" station. An area of approximately 577 ha is currently authorized to be irrigated in this area. In the early part of the season irrigation takes place from run-of-river flows. Surface flows usually reduce to less than 50 litres per second by June, and cease completely by August or September, (G.S. 917001D at "Rockfields"). During the latter part of the year until the onset of the storm season in December, irrigators rely upon water drawn from the bed sands of the river using shallow interception galleries, sand-spear or gravel-packed bore-holes. Recent applications for abstraction from this source total 22 000 ML per annum, indicating that a significant demand exists for irrigation development in this area. In order to develop allocation policy to meet the water supply demand, with any degree of sustainability, an understanding of the catchment hydrology needs to be attained. This project attempts to quantify the water resource contained in the bed sands after the cessation of surface flow.

2.0 INVESTIGATION METHODOLOGY

Eight locations were selected, at more or less regular intervals, over the 55 km reach of the Gilbert River at which to construct a line of bore-holes across the river bed. The purpose of the exercise being to determine the depth and composition of the bed material and thereby assess its potential as a ground-water aquifer. The bore-line locations were selected more on the basis of ease of access rather than topographic or geological attributes. The investigation work at each of the selected locations involved construction of a series of uncased exploration holes to the lower extent of any potential aquifer material. These holes penetrated to either rock, clay, silt or combinations thereof. Bore-holes were located generally within the active river channel. Where continuation of potential aquifer material beneath the high banks was indicated, (and access possible), additional holes were

drilled in the high banks. Spacing of holes varied from 32 metres to 40 metres across the river-bed. One of these holes, generally the deepest, was then selected as the site for a sample hole to establish the quality of the aquifer material.

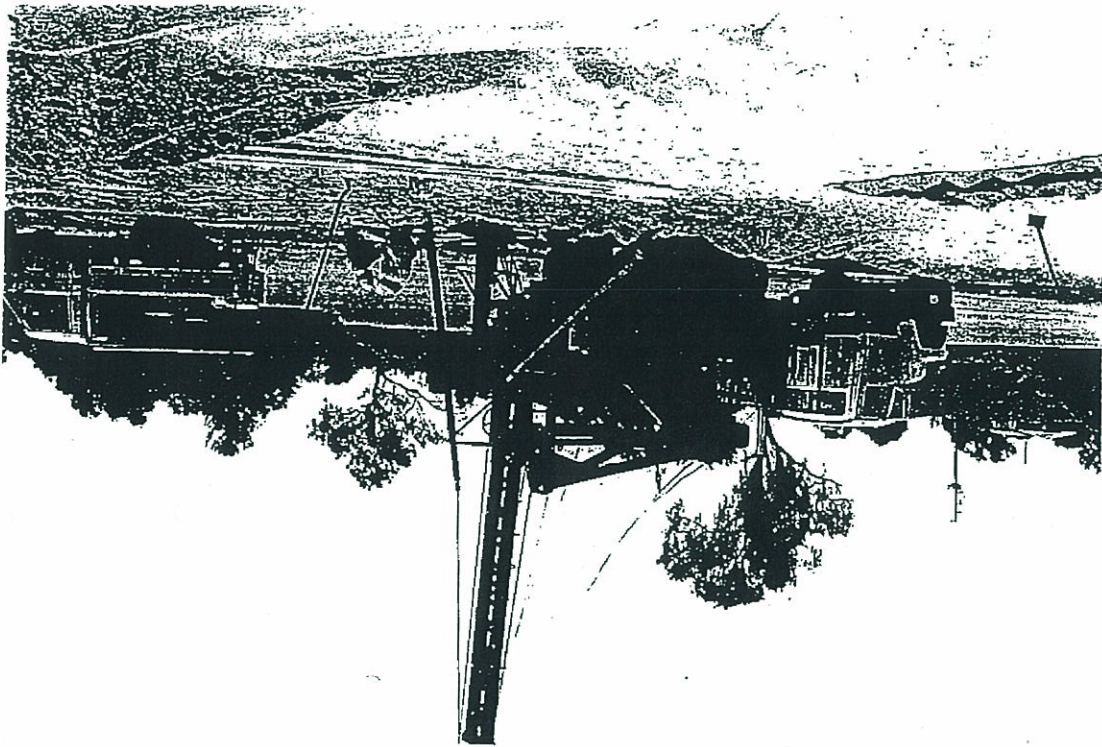
- Drill-holes of 152 mm diameter penetrated the saturated, unconsolidated sediments to basement. Depths of the holes varied from 1 metre to 32 metres. A total of eighty-seven (87) test holes was constructed.
- A single 200 mm diameter bore-hole was constructed by percussion methods adjacent to one of the deeper test holes at five of the eight locations. Washed, but otherwise uncontaminated, strata samples were obtained at one metre intervals for the full depth of the clean sand/gravel. Percussion drilling continued only one or two metres into the underlying clayed material, ranging in depth from 5 to 13 metres approximately. They were intended to sample the more productive, upper section of the aquifer as it was considered that the underlying clayed material has such low porosity and transmissivity as to make extraction of water impracticable.
- Stouff P.V.C. casing was inserted into the 200 mm percussion holes to serve as observation bores to allow water-table monitoring.
- Sieve analyses were carried out on every second sample obtained from the five sample percussion-drilled holes. Results have been plotted on a spreadsheet to allow mean values of Coefficient of Uniformity and Effective Grain Size to be determined, and thereby accurate assessment of porosity to be made.
- Each of the bore hole lines was surveyed using a Total-Station and river bed profiles were plotted. Standing water level elevations were added to the cross-section plots, as well as depth to lower extent of the clean sand/gravel. This allowed the mean cross-sectional area of saturated, clean sand/gravel aquifer to be determined. Mean values for aquifer storativity may be derived by integration of the porosity result and the available saturated river-bed volume.
- At a few of the locations, saturated aquifer material appears to extend beyond the limits of the bore lines on one or both sides of the river. An accurate assessment of the volume of the aquifer beneath the river levees and flood-plain is beyond the scope of this investigation. Quantitative analyses derived from this investigation assume that the aquifer is confined within the high banks of the river. Results are therefore considered to be conservative.

3.0 DRILLING PROGRAMME

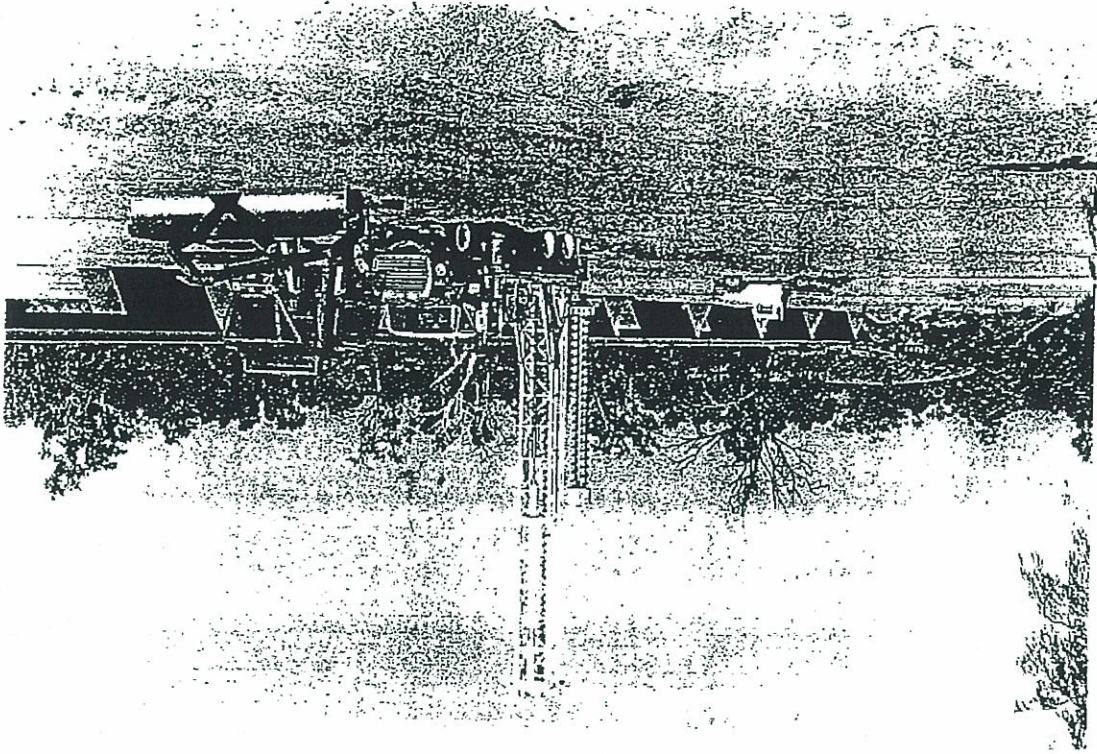
Auger drilling investigation was carried out using a Bourne A25 continuous auger rig. The rig is owned and operated by Neil Heiniger who is a licensed driller under the Water Resources Act 1989. Auger holes were constructed at regular intervals across the Gilbert River at each of the eight selected cross-sections. Spacing of holes varied between 32 and 40 metres.

Strata samples were obtained from holes constructed by a percussion or cable tool rig. A Hydromaster percussion plant was used to push and drive 200 mm steel casing ahead of a 150 mm sand pump. (130 mm aperture). A positive head of water was maintained inside the casing to prevent outside material from entering the casing and contaminating the sample. Sand and gravel material was retrieved from the sand pump at regular intervals depending on rate of progress, and combined into a 2 kg sample considered representative of each metre of drilled.

Department of Natural Resources
GILBERT RIVER BED SAND INVESTIGATION
SEPT-OCT 1998



Bourne A25 Continuous Auger Rig on Gilbert River Bridge Line
being used to determine depth of bed sand.



Hydromaster Percussion Rig on Riverview Line
being used to obtain strata samples for sieve analysis

4.0 RESULTS OF DRILLING INVESTIGATIONS

4.1 Prestwood Line

Location: Approximately 1 km up-stream of the "Prestwood" homestead at about AMTD 321 km.

Description: The river at this location has a broad low level channel about 140 m wide. The right bank rises to a slightly elevated terrace at the toe, with further rises to a series of sand hills forming the right bank levee. The left bank rises about 1.5 m to the toe of a near-vertical high bank, the top of which is about 5 m above the toe. Total width of the river bed is approximately 325 m. Free water was evident at the lowest point of the river bed, in the vicinity of hole #8.

Auger-drill Investigation: Fourteen holes were drilled at approximately 40 m spacing, except for holes 12, 1 and 2 where spacing is 14 m and 20 m respectively. Total auger drill depth for this line was 208.7 metres. Clean sand and gravel was encountered in the bed section holes, (1-10), except for #11 at the toe of the left bank, which went straight into brown silt. Depth of clean sand and gravel ranged from 2 m in hole #1, at the toe of the right bank, to 6.6 m in hole #4 at the edge of a minor channel.

In all cases the clean material was underlain by clayed sand and gravel, generally increasing in fines with depth, to bottom-out in hard rock (generally granite) at between 8.0 m and 25.3 m.

Percussion Drilling Investigation: No percussion drilling was carried out on this line. It was decided to exclude this line from the sampling investigations as the depth of aquifer material below the normal water table level is minimal. It was considered that better information would be available from the deeper sites.

4.2 Riverview Line

Location: Immediately up-stream of the "Riverview" access crossing at about AMTD 314 km, adjacent to the Bureau of Meteorology flood warning station

Description: The river at this location has a broad, fairly uniform sandy bed with a narrow low-flow channel located centre-left. Both river banks rise rapidly to a well-developed levee on the right bank, and to granite outcrops on the left. Total width of the river bed is approximately 325 m. No free water was evident at the lowest point of the river bed, but a pit excavated for drill water adjacent to hole #4 had a standing water level of about 1.75 m below natural surface.

Auger-drill Investigation: Twelve holes were drilled at approximately 36 m spacing. Holes #1 and 12 are located high on either river bank, 4 to 5 m above the bed. Total auger drill depth for this line was 197.3 metres. Clean sand and gravel was encountered in all holes except for #1 at the top of the left bank, which went straight into brown silt. Depth of clean sand and gravel ranged from 3.3 m in holes #10 and 11, near the right bank, to 13.5 m in hole #4 near the left bank of the minor channel. The clean sand and gravel strata was much thicker from the centre-line towards the left bank.

In all cases the clean material was underlain by clayed sand and gravel to about 15 m, with a distinct ridge of dense clay in the centre of the channel, (hole #7). Below this highly clayed layer is a dense gravelly clay which persists for between 15.3 and 22.5 m.

Percussion Drilling Investigation: Percussion drilling was carried out adjacent to auger hole #4 for the purpose of obtaining strata samples of the sand/gravel and the underlying clayed material. Drilling proceeded satisfactorily at first, but slowed when a dense layer of quite large gravel was encountered through which the casing could not be pushed. The casing was then alternately pumped and driven to a final depth of 14 m, finishing in dense gravelly clay.

4.3 Blancourt Line

Location: Approximately 6.5 km down-stream of the "Blancourt" homestead at about AMTD 302 km.

Description: The river at this location has a fairly narrow low-flow channel about 100 m wide adjacent to the right bank. The right bank rises steeply to the crest of the levee about 8 m above the bed level. The remaining 250 m bed section comprises undulating sand ridges. The left bank rises about 2.5 m to the toe of a near-vertical high bank, the top of which is about 6.5 m above the toe. Free water was evident at the lowest point of the river bed, in the vicinity of hole #2. A deeper hole exists nearby at the toe of the right bank. This provides near-permanent stock-water.

Auger-drill Investigation: Eleven holes were drilled at approximately 35 m spacing. Total auger drill depth for this line was 230.5 metres. Clean sand and gravel was encountered in all holes. Depth of clean sand and gravel ranged from 4.5 m in hole #5, to 6 m in hole #4; both towards the centre-right of the river bed.

In most cases the clean material was underlain by clayed sand and gravel, generally increasing in fines with depth, to bottom-out in dense cemented clayey gravel at between 15.0 and 25.0 m. Test holes #10 and #11, at the toe of the left bank exhibited similar upper strata but finished in green/brown silt at 12 and 7.5 m respectively.

Saturated sand and gravel appears to extend beneath both river banks beyond the limits of the section drilled as indicated in test-holes #1 and #11. No attempt was made to further define the limit of the deposit.

Percussion Drilling Investigation: A percussion drill hole was drilled on this line adjacent to test hole #4. This hole penetrated the clean sand/gravel strata, finishing in the clayed sand/gravel at 5.2 m.

4.4 Forest Home Line

Location: Approximately 1.8 km down-stream of the eastern boundary of "Forest Home" at about AMTD 294 km. The line is located at the property's river crossing. Three production bores are located at the toe of the right bank.

Description: The river at this location has a broad near level channel almost 300 m wide. The right bank rises sharply to a terrace about 3 m above the bed, before falling slightly to a minor side channel. The left bank rises about 6 m directly to the top of the river levee. Free water was evident at the lowest point of the river bed, in the vicinity of hole #1.

Auger-drill Investigation: Twelve holes were drilled at an average 36 m spacing. Total auger drill depth for this line was 189.4 metres. Clean sand and gravel was encountered in all holes except for #10 at the top of the left bank, which went straight into brown silt. Depth of clean sand and gravel ranged from 1.3 m in hole #5, in the centre of the bed to 7.5 m in hole #6 immediately adjacent. An extra hole, #11, drilled between 5 and 6 verified the steep dip in the lower margin of the sand/gravel strata.

In all cases the clean material was underlain by clayed sand and gravel, generally increasing in fines with depth. To bottom-out in dense silt or clay at between 12.0 m and 22.5 m.

Evidence from test-hole #12 on the lower right bank suggests that saturated sand and gravel extends beneath the right bank beyond the limits of the section drilled. This is supported by the presence of a production bore located 30 m north of test-hole #12 in an upper-level flood channel. No attempt was made to further define the limit of the deposit.

Percussion Drilling Investigation: A percussion drill hole was drilled on this line at test hole #2. This hole penetrated the clean sand/gravel strata, finishing in the clayed sand/gravel at 12.0 m.

4.5 Rockview Line

Location: Approximately 1 km down-stream of the "Rockview" boundary at about AMTD 284 km.

Description: The river at this location has a narrow main channel about 80 m wide and a series of upper level channels on the left side. The left bank rises in a series of terraces up to outcrops of fine-grained sand-stone or

siltstone. (Langdon River Formation). The right bank rises steeply to the top of a near-vertical high bank, before flattening off to the crest of a broad natural levee. Total width of the section drilled is approximately 346 m. Free water was evident in a water-hole adjacent to the lowest point of the section in the vicinity of hole #3.

Auger-drill Investigation: Eight test-holes were drilled at approximately 38 m spacing from the toe of the right bank to the sandstone out-crops on the lower left bank. Total auger drill depth for this line was 29 metres. Clean sand and gravel was encountered in the lower bed section holes. (1-3), changing to clayed sand/gravel in hole #4 at the top of the first terrace. Depth of clean sand and gravel ranged from 1 m over-lying the sandstone in holes 5 to 8 inclusive, to 6.9 m in hole #2 in the centre of the channel.

The clean material was underlain by clayed sand and gravel, to bottom-out in sandstone in all but hole #1 at between 1.0 m and 7.3 m.

Evidence from test-hole #1 suggests that saturated sand and gravel may extend beneath the right bank beyond the limits of the section drilled. No attempt was made to further define the limit of the deposit.

Percussion Drilling Investigation: No percussion drilling was carried out on this line. It was decided to exclude this line from the sampling investigations as the volume of aquifer material below the normal water table level is minimal.

4.6 Gilbert Bridge Line

Location: Approximately 30 metres up-stream of the Gulf Development Road bridge at about AMTD 276 km.

Description: The river at this location has a broad channel about 190 m wide, with a minor low-flow channel at the toe of the left bank. The left bank rises steeply for about 7 or 8 m to the top of the bank. The right bank rises through a series of exposed sandstone out-crops to the crest of the right bank levee. Total width of the river bed is approximately 192 m. Free water was evident in the low-flow channel in the vicinity of hole #1.

Auger-drill Investigation: Eight test holes were drilled at approximately 35 m spacing. Total auger drill depth for this line was 201.8 metres. Clean sand and gravel was encountered in the bed section holes. (1-6), underlain by clayed sand/gravel and cemented granite sands. Test-hole #7, on the right bank terrace encountered loose dry sand over sandstone at 1 m. Depth of clean sand and gravel ranged from 6 m in hole #3, to 12 m in hole #5 in the middle of the stream channel.

A thin lens of saturated fine sand identified in test hole #8 may extend beneath the left bank beyond the limits of the section drilled. No attempt was made to further define the limit of the deposit.

Percussion Drilling Investigation: A percussion drill hole was drilled on this line at test hole #5. This hole penetrated the clean sand/gravel strata, finishing in the clayed sand/gravel at 11.2 m.

4.7 Neem Trees Line

Location: At the "Neem Trees" plantation on the old road crossing at Gilbert River township at about AMTD 268 km.

Description: The river at this location has a distinct low-flow channel about 80 m wide at the toe of the right bank, another slightly higher channel 25 m wide at the toe of the left bank and a third upper-level channel some 10 m wide beyond this. The intervening bed comprises undulating sand terraces and silted tea-tree islands. The right bank rises steeply to the crest of the levee about 8 m above bed level. Beyond the upper-level flood channel the left bank rises a further 3 or 4 m to the crest of the levee. Total width of the river bed drilled is approximately 427 m. Free water was evident in a small channel at the lowest point of the river bed, in the vicinity of hole #3.

Auger-drill Investigation: Fourteen holes were drilled at approximately 40 m spacing, except for holes 12, 1 and 2 where spacing is 14 m and 20 m respectively. Total auger drill depth for this line was 208.7 metres. Clean sand and gravel was encountered in the bed section holes. (1-10), except for #11 at the toe of the left bank, which went straight into brown silt. Depth of clean sand and gravel ranged from 2 m in hole #1, at the toe of the right bank, to 6.6 m in hole #4 at the edge of a minor channel.

In all cases the clean material was underlain by clayed sand and gravel, generally increasing in fines with depth, to bottom-out in hard rock (generally granite) at between 8.0 m and 25.3 m. Evidence from test-hole #13 indicates that up to a 6m thickness of saturated sand and gravel may extend beneath the right bank beyond the limits of the section drilled. No attempt was made to further define the extent of the deposit.

Percussion Drilling Investigation: No percussion drilling was carried out on this line. It was decided to exclude this line from the sampling investigations as the depth of aquifer material below the normal water table level is minimal. It was considered that better information would be available from the deeper sites.

4.8 Godfrey's Line

Location: At the down-stream boundary of Lot 8 on ETL6 owned by R. & D. Godfrey at about AMTD 261 km.

Description: The river at this location has a narrow low-flow channel about 45 m wide at the toe of the right bank and another slightly lower channel 150 m wide at the toe of the left bank. The intervening bed comprises undulating sand terraces and silted tea-tree islands. The right bank rises near vertically for about 9 or 10 m to the crest of the levee. The left bank also rises steeply to about the same elevation. Total width of the river bed drilled is approximately 336 m. Standing water level was approximately 0.8 m below the bed in the vicinity of test-hole #1.

Auger-drill Investigation: Nine test holes were drilled at approximately 36 m spacing. Total auger drill depth for this line was 55.1 metres. Clean sand and gravel was encountered in all test-holes except for #1 and #9 at the extremities of the section. These two holes exhibited clayed sand/gravel to 5 m and 3 m respectively, over dense moulded clay. Depth of clean sand and gravel ranged from 3.6 m in hole #8 to 7.0 m in hole #3 at the edge of the right bank channel.

In all cases the clean material was underlain by clayed sand and gravel, generally increasing in fines with depth, to bottom-out in sandstone at between 3.6 m and 7.8 m.

Percussion Drilling Investigation: A percussion drill hole was drilled on this line adjacent to test hole #2. This hole penetrated the clean sand/gravel strata, finishing in the clayed sand/gravel at 6.5 m.

8.0 RECOMMENDATIONS FOR WATER RESOURCE DEVELOPMENT

It is considered that water resource allocations for irrigation should be based on a total bed sand storage volume of 18 000 megalitres being available when surface flow ceases.

It should be noted that, in the author's opinion:

- The total amount, abstraction rate actually achievable and reliability of supply will be governed as much by the location of the abstraction point in respect to the shallow rock "controls", as by the characteristics of the aquifer at that particular location.
- Additional information is required as to the location and depth of the various geological features that may impact upon the system.
- Additional information is required as to the contribution made by the unmapped portions of the aquifer underlying the river banks.
- Hydrologic modeling of the entire catchment will be necessary to accurately determine the maximum sustainable, yield able to be allocated from both run-of-river and bed-sand abstraction.

This report was prepared by Jeff Benjamin of Australian Water Management & Design who, whilst in the service of the Department of Natural Resources was responsible for supervision of the drilling investigation and conducted the laboratory analyses and calculations.

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ACKNOWLEDGEMENTS

The following officers of the Department of Natural Resources, Maracba, assisted with the conduct of this investigation and / or production of this report. Their efforts are greatly appreciated.

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- Mr. Graham Herbert, Senior Technical Officer, (Hydrology), Resource Management.
- Mr. Jason Douglas, Technical Officer, Stream Management, Resource Management.
- Mr. Mark Bartlett, Technical Officer, Technical Services Group, State Water Projects

5.0 RESULTS OF SIEVE ANALYSES

Particle-size determinations, or sieve analyses, were carried out on alternate one-metre samples of the clean sand and gravel obtained from the percussion holes. As the percussion-drilled holes were constructed under saturated conditions, most fine material, if present, was washed from the sample in the drilling process. Observation of the water emptied from the sand pump indicated that in general very little clay or silt fines were present in the aquifer material. No sieve analyses have been conducted on the clayed sand and gravel because the fine fraction would generally have been washed from the sample. The sieve analysis results and the aquifer parameters calculated therefrom refer only to the clean, upper sand and gravel strata.

The entire sample of approximately 2 kg was air dried before passing through a sieve set comprising 12 sieves ranging from 37.5 mm to 0.075 mm. The mass of material retained on each sieve was weighed and the percentage of the total sample weight calculated. A particle size distribution curve was then drawn showing the percentage of the sample retained on each sieve. The Effective Grain Size, D_{10} , being the grain size at which 10% of the sample is finer and D_{60} , the size at which 60% of the sample is finer were obtained from the distribution curve. The Coefficient of Uniformity, C_u , was then calculated for each sample.

Twenty-five samples were analysed in this manner. Effective Grain Size varies from 0.32 mm to 2.8 mm, with a mean of 0.84 mm. Coefficient of Uniformity values vary from 3.3 to 12.6, with a mean of 6.4 and median value of 5.2.

6.0 AREAL EXTENT OF THE AQUIFER

The bore-hole lines were surveyed to obtain natural surface elevation and location at each of the bore-holes. River bed profiles were plotted and strata information added to allow determination of the available cross-sectional area of the saturated aquifer. Cross-sectional area of the saturated material ranges from 386 m² at the "Rockyview" line to 2 420 m² at "Riverview", with a mean area of 1 151 m². Therefore the volume of saturated, clean sand and gravel contained within the 59 kilometre length investigated is estimated at 67 909 000 m³.

It is recognised that as the drilling investigation did not extend to the outer limits of the aquifer, estimation of its areal extent will be conservative. It is considered that an extensive and detailed drilling programme would be needed to accurately locate the margins of the potential aquifer.

7.0 AQUIFER PARAMETERS AND STORAGE

The mean and median Coefficient of Uniformity values of 5.0 and 6.02 respectively indicate that the aquifer material is a moderately poorly sorted, (or moderately well mixed) sand and gravel. As such it is expected that this material has a porosity of between 25 to 30%. [Ref: Fetter, C.W., 1994-*Applied Hydrogeology*, Merrill Press] The volume of water contained within the river bed material in the area under investigation is therefore between 16 980 megalitres to 20 370 megalitres.

The average bed slope of the Gilbert River in this vicinity is about 1.2 metres per kilometre. It may be assumed that the average gradient of the aquifer is similar. The presence of several geological features however, is thought to result in local variations in the aquifer gradient. This is evidenced by the fact that surface flow, or semi-permanent water-holes appear at irregular intervals, presumably at the down-stream control points of sections of flatter grade. The effect of these "controls" is unknown, but it is reasonable to expect that they act as physical barriers to ground-water during the latter part of the year, causing the aquifer to be broken up into discrete "pools".